ASSESSMENT OF THE PREVALENCE AND MANAGEMENT OF ELDERLY PATIENTS WITH TYPE 2 DIABETES MELLITUS AND MULTIMORBIDITIES AT PRIMARY LEVEL CARE INSTITUTIONS IN THAILAND

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Abstract. It is important to correctly manage elderly patient with type 2 diabetes mellitus (T2DM) with multimorbidity to prevent an increase in morbidity and mortality. This study had two parts. In Part 1 we aimed to determine the prevalence of multimorbidity among elderly T2DM patients in Thailand and in Part 2 we aimed to assess the management of elderly T2DM patients in Thailand at primary level care (PLC) institutions in order to inform strategies to reduce morbidity and mortality in the study population. Inclusion criteria for subjects in both study parts were being aged ≥60 years and having T2DM. Subjects in both study parts having incomplete or inaccurate medical records or having only one visit for T2DM were excluded from the study. The data used for Part 1 of this study were population health data obtained from the Ministry of Public Health, Health Data Center (HDC) for the year 2019. The data used for Part 2 of this study were obtained from the medical records of the study subjects at 4 purposively selected PLC district hospitals. The care given at these 4 hospitals was compared with the Thailand's 2017 Clinical Practice Guidelines for Diabetes. 529,277 subjects were included in Part 1 of the study, 348,376 (65.82%) females. The mean (±standard deviation (SD)) age of study subjects was 70.0 (±8.8) years. 377,630 subjects (71.35%) had multimorbidity. Of the subjects in Part 1, among patients who received care at all PLC institutions, 157,951 (71.72%) had ≥1 comorbid condition in addition to their T2DM. 6,460 subjects were included in Part 2 of the study, 4,171 (64.57%) females. The mean (±SD) age of subjects was 70.0

(±7.6) years. Of the subjects in Part 2, 6,112 (94.61%) had ≥1 comorbid condition. The most common comorbid conditions were hypertension (*n* = 5,045, 78.10%), dyslipidemia (*n* = 3,125, 48.37% and renal insufficiency (*n* = 2,684, 41.55%). Among subjects with multimorbidity at the 4 study institutions, from 648 of 1,090 (59.45%) to 867 of 1,054 (82.26%) subjects had yearly HbA1c testing following the recommendations in the 2017 Clinical Practice Guidelines for Diabetes and from 97 of 1,090 (14.97%) to 256 of 1,126 (27.71%) subjects achieved the HbA1c target of ≤7.0% following the recommendations in the 2017 Clinical Practice Guidelines for Diabetes. In summary, in our study population, the proportion of subjects with multimorbidity was relatively high and much of the care at the PLC study institutions did not meet recommended guidelines. We conclude there is a need to improve the care of elderly patients with T2DM at the study institutions. Further studies are needed to determine what factors caused the failure to reach care guidelines in the study population at the study PLC institutions and how to improve compliance rates with those guidelines, in order to reduce morbidity and mortality in the study population at the studied PLC institutions.

Keywords: multimorbidity, elderly care, type 2 diabetes (T2DM), primary level care (PLC), Thailand, healthcare management

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INTRODUCTION

Multimorbidity among elderly patients with type 2 diabetes mellitus (T2DM) is defined here as the presence of ≥2 chronic diseases in an elderly patient, one of which is T2DM; multimorbidity increases the risk for greater morbidity and mortality (WHO, 2016). Management of these patients requires a change from disease-specific treatment to integrated, patient-centered care that addresses the overall patient and their comorbid conditions (WHO, 2016; NICE, 2016). More

than one-third of adults worldwide have multimorbidity (Hajat and Stein, 2018; Johnston *et al*, 2019; Chowdhury, 2023). The International Diabetes Foundation, in 2025, reported that during 2021 diabetes was estimated to be one of the most common chronic medical conditions, affecting approximately 537 million adults worldwide, and this number is projected to rise to 643 million by 2030 and 783 million by 2045, with a substantial proportion of these cases occurring in low- and middle-income countries (IDF, 2025).

Elderly patients with diabetes are more likely to experience multimorbidity and frailty than elderly patients without diabetes, reducing the quality of life and satisfaction with the healthcare received (Sinclair and Abdelhafiz, 2022).

Managing multiple chronic conditions by several providers can be complex, leading to fragmented care and challenges in treatment coordination. Variations in management guidelines, formularies and electronic records can lead to duplicate investigations, misaligned treatment goals, and ambiguous accountability for follow-up. Having a multidisciplinary team working together with an overall treatment plan and medication prescribing might reduce these problems and improve quality of care (Al Yamani *et al*, 2022). Care should be guided by multimorbidity-oriented guidelines that synthesize evidence into practical, whole-patient recommendations, rather than discrete disease-specific advice (Wallace *et al*, 2015; Aramrat *et al*, 2022). However, most guidelines still focus on single conditions and provide limited direction for multimorbidity.

Thailand's health system is guided by the Ministry of Public Health's Service Plan for 2023-2027, which is built on three pillars: 1) seamless service networks, 2) self-containment within catchment areas, and 3) a tiered referral cascade aligned with facility capability (MOPH Thailand, 2022). In this

referral-oriented model, primary level care (PLC) institutions serve as the entry point to handle general disease without severe conditions and coordinate onward referral of patients with increasing clinical complexity, such as those with severe multimorbidity, to secondary and tertiary level centers.

Under the Primary Health Care System Act (Royal Thai Government, 2019), service delivery emphasizes holistic, standards-based care through Family Care Teams (FCTs), typically led by family physicians with expertise in holistic care. In practice, however, most frontline physicians are general practitioners or internists who primarily manage single conditions without serious complications. Current care pathways still rely largely on single-disease clinical practice guidelines. This type of care can create gaps in quality at some PLC institutions among patients with complex multimorbidity (Division of Primary Health Care System Support, 2019).

Despite the growing burden of multimorbidity, its prevalence and management of patients with multimorbidity at PLC institutions in Thailand has been little studied. This study had two parts. In Part 1 we aimed to determine the prevalence of multimorbidity among elderly patients with T2DM in Thailand and in Part 2 we aimed to assess the management of elderly patients with T2DM in Thailand at selected PLC institutions in order to inform strategies to reduce morbidity and mortality in this population.

MATERIALS AND METHODS

This 2-part study was a retrospective review of data from 2 sources. The data for Part 1 was national-level aggregate data obtained from the Ministry of Public Health, Health Data Center (HDC) for the year 2019. The data recorded were the number of elderly patients with T2DM and of these, the prevalence of multimorbidity. The HDC is a centralized health data warehouse aggregating datasets extracted via Extract-Transform-Load (ETL)

pipelines from Hospital Information Systems (HIS) nationwide. Data for Part 2 of the study were obtained from the records of elderly patients with T2DM treated at 4 purposively selected PLC district hospitals and their Subdistrict Health Promoting Hospital (SHPH) networks. The patient care of these subjects recorded in their medical records was compared with recommended standards found in the 2017 Clinical Practice Guidelines for Diabetes in Thailand (DAT/EST/DMS-MOPH/NHSO, 2017).

Inclusion criteria for study subjects in both parts of the study were being aged ≥60 years and having T2DM identified using ICD-10 codes E10-E14. Exclusion criteria for study subjects in both parts of the study, were having missing data for subject gender, age, date of birth, visit date(s), having a missing diagnostic code for T2DM or having only a single visit at the study institution. For Part 2, we excluded records suspected of containing non-verifiable errors based on a predefined data-quality protocol checking for: 1) internal inconsistencies such as biologically implausible values (a HbAc level <5%, negative ages or dates out of sequence), 2) coding anomalies (invalid diagnosis/procedure/medication codes), 3) duplicate encounters, and 4) records having incomplete lineage (records lacking source traceability to the original source). Suspect records were flagged via range checks, cross-field validations, temporal logic rules and de-duplication routines and those that could not be verified by the audit trail were excluded.

Multimorbidity was classified based on a list of 46 chronic conditions described previously (Koller *et al*, 2014) and defined as the presence of ≥2 chronic conditions in a single patient and in the case of our study, one of which was T2DM. Patients diagnosed with having T2DM but no additional chronic conditions were classified as having T2DM only. Patients with T2DM and at least one other chronic condition were categorized as having T2DM with multimorbidity.

Descriptive statistics were used to describe the prevalence of comorbidities and the levels of care accessed by the subjects in Part 1 of the study. Descriptive statistics were also used to describe the prevalence of comorbidities, the frequency of accessing PLC institutions, the cost burdens, the frequency of adherence to the 2017 Diabetes Clinical Practice Guidelines for Diabetes and treatment outcomes of subjects in Part 2 of the study.

This study was approved by the Human Research Ethics Committee of Thammasat University (Science) COA No. 125/2563.

RESULTS

Part 1 of the study

A total of 529,277 adults aged ≥60 years were seen for T2DM at hospitals under the Ministry of Public Health, Thailand during 2019, 348,376 (65.82%) females. The mean (±standard deviation (SD)) age of the study subjects was 70.0 (±8.8) years. A total of 377,630 subjects (71.35%) had at least one additional comorbid condition (Table 1).

Of the total of 529,277 patients included in the dataset, classification by level of healthcare facility utilization was feasible for only 479,206 patients. There was missing data in 50,071 patients (9.46%). Of the 479,206 subjects, 220,242 (45.96%) were managed at the PLC institutions, 166,759 (34.80%) at the secondary level care institutions and 92,205 (19.24%) at the tertiary level care institutions. Of those managed at the PLC institutions, 62,291 (28.28%) had no comorbidities, 145,224 (65.94%) had 1 comorbid condition and 12,727 (5.78%) had ≥2 comorbid conditions. Of those managed at the secondary level care institutions, 43,050 (25.82%) had no comorbidities, 92,989 (55.76%) had 1 comorbid condition and 30,720 (18.42%) had ≥2 comorbid conditions. Of those managed at the tertiary level care institutions, 20,933 (22.70%) had no comorbidities, 47,577 (51.60%) had 1 comorbid condition and 23,695 (25.70%)

Table 1

Characteristics of study subjects (Part 1 of our study) obtained from the 2019 Health Data Center database (N = 529,277)

Characteristics	Frequency* *n* (%)
Gender	
Female	348,376 (65.82)
Mean (±standard deviation) subject age in years	70.0 (8.8)
Age groups	
60-69 years	287,775 (54.37)
70-79 years	172,397 (32.57)
80-89 years	62,947 (11.90)
≥90 years	6,158 (1.16)
Numbers of study subjects with and without comorbid conditions	
T2DM without comorbid conditions	151,647 (28.65)
T2DM with multimorbid conditions	
With 1 additional comorbid condition	310,663 (58.70)
With 2 additional comorbid conditions	56,103 (10.60)
With ≥3 additional comorbid conditions	10,864 (2.05)

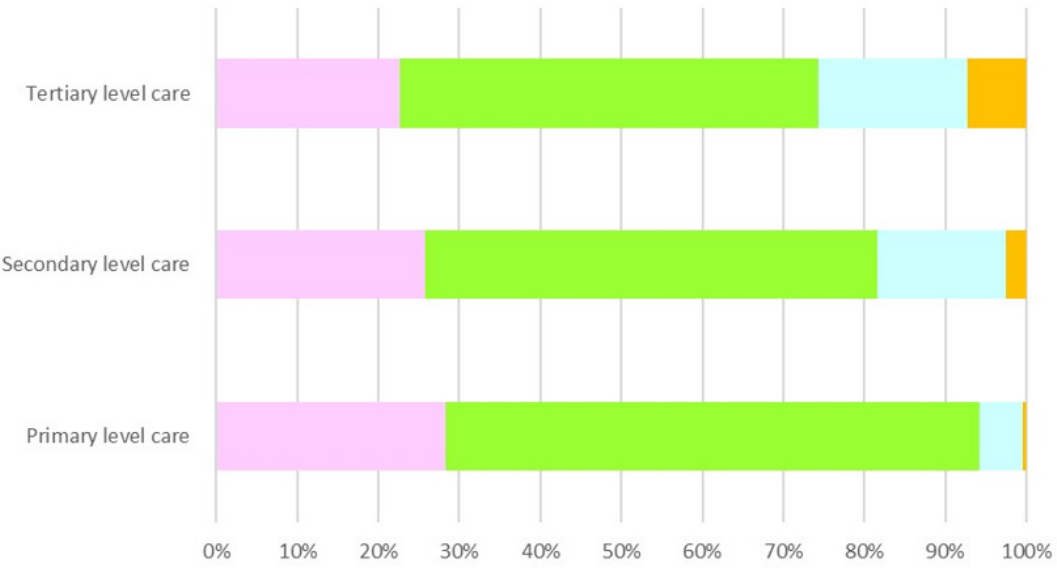
*Unless otherwise stated

T2DM: type 2 diabetes mellitus

had ≥2 comorbid conditions. Of those managed at the secondary level care institutions, 43,050 (25.82%) had no comorbid conditions and should have been managed at the PLC institutions and of those managed at the tertiary level care institutions, 20,933 (22.70%) should have been managed at the PLC institutions (Fig 1).

Part 2 of the study

Of the 4 study PLC district hospitals, Hospitals 1, 2 and 3 were in Central Thailand and Hospital 4 was in northeastern Thailand. The numbers of study subjects at the 4 study hospitals ranged from 1,279 to 2,096 subjects (Table 2). The hospitals ranged in size from 32 to 178 beds. A total of 6,460



	Primary level care	Secondary level care	Tertiary level care
0 D	62,291	43,050	20,933
1 D	145,224	92,989	47,577
2 D	11,867	26,631	17,006
≥3 D	860	4,089	6,689

Fig 1 - Proportions of subjects and what level of care they obtained their medical care from based on the number of comorbid diseases in addition to their T2DM (n = 479,206)

Note: missing data = 50,071 (9.46%)

0 D: T2DM only; 1 D: T2DM + 1 comorbid disease; 2 D: T2DM + 2 chronic diseases; ≥3 D: T2DM + ≥3 chronic diseases

T2DM: type 2 diabetes mellitus

subjects were included in Part 2 of the study, 4,171 (64.57%) females. The mean (±SD) age of study subjects was 70.0 (±7.6) years. Of subjects with comorbid conditions (6,112, 94.61%), the 3 most common conditions were hypertension (*n* = 5,045, 18.10%), dyslipidemia (*n* = 3,125, 48.37%) and renal insufficiency (*n* = 2,684, 41.55%). The other common conditions were liver disease, dizziness, severe vision reduction, arthritis, chronic low back pain, anemia and stroke (Fig 2).

Of the 6,460 subjects in Part 2 of the study, 348 (5.39%) had no comorbidities, 1,090 (16.87%) had 1 comorbid condition and 5,022 (77.74%) had ≥2 comorbid conditions. Among subjects aged 60-69 years, the most common number of comorbid conditions was 2, but among subjects aged 70-79 years, the most common number of comorbid conditions was 3 (Fig 3).

The greater the number of comorbid conditions the subject had, the greater the expense to the

Table 2

Characteristics of the 4 selected study hospitals (Part 2 of our study) (N = 6,460)

Characteristics	Results			
Mean (± standard deviation) age in years	70.0 (±7.6)			
Female gender, *n* (%)	4,171 (64.57)			
Variables	Study hospitals			
	Hospital #1	Hospital #2	Hospital #3	Hospital #4
Region of Thailand	Central	Central	Central	Northeast
In-patient bed capacity	32	178	38	60
Number of elderly patients with T2DM	1,279	1,778	1,307	2,096

T2DM: type 2 diabetes mellitus

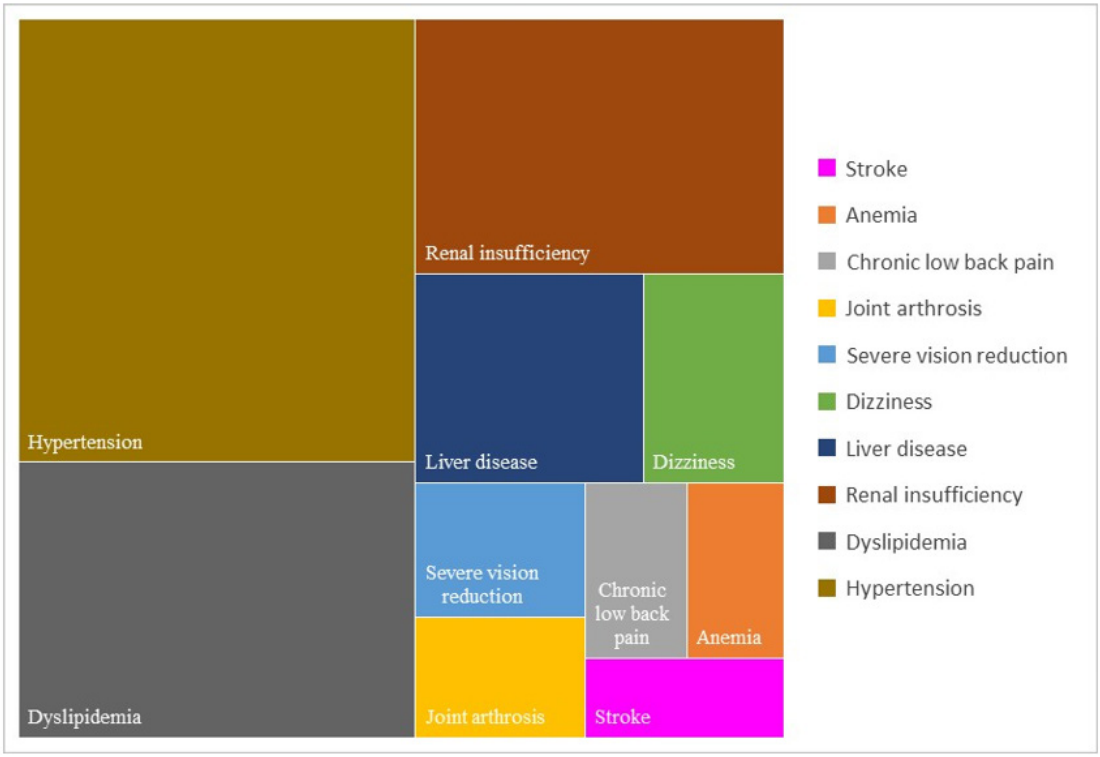


Fig 2 - The 10 most common chronic comorbid conditions among study subjects receiving care at the primary level care institutions

Thai government there was but none of the patients had to pay anything out-of-pocket (Table 3).

Routine laboratory test results commonly prescribed for diabetes management, including hemoglobin A1c (HbA1c), high-density lipoprotein (HDL) cholesterol, and triglycerides (TG) were summarized in Table 4.

HbA1c testing

The number of subjects who had recommended HbA1c testing (once per year) was 183 (52.59%) among those with no comorbid conditions and 1,126 (82.06%) among those with ≥5 comorbid conditions. The number of subjects with a HbA1c level within the target range (<7%)

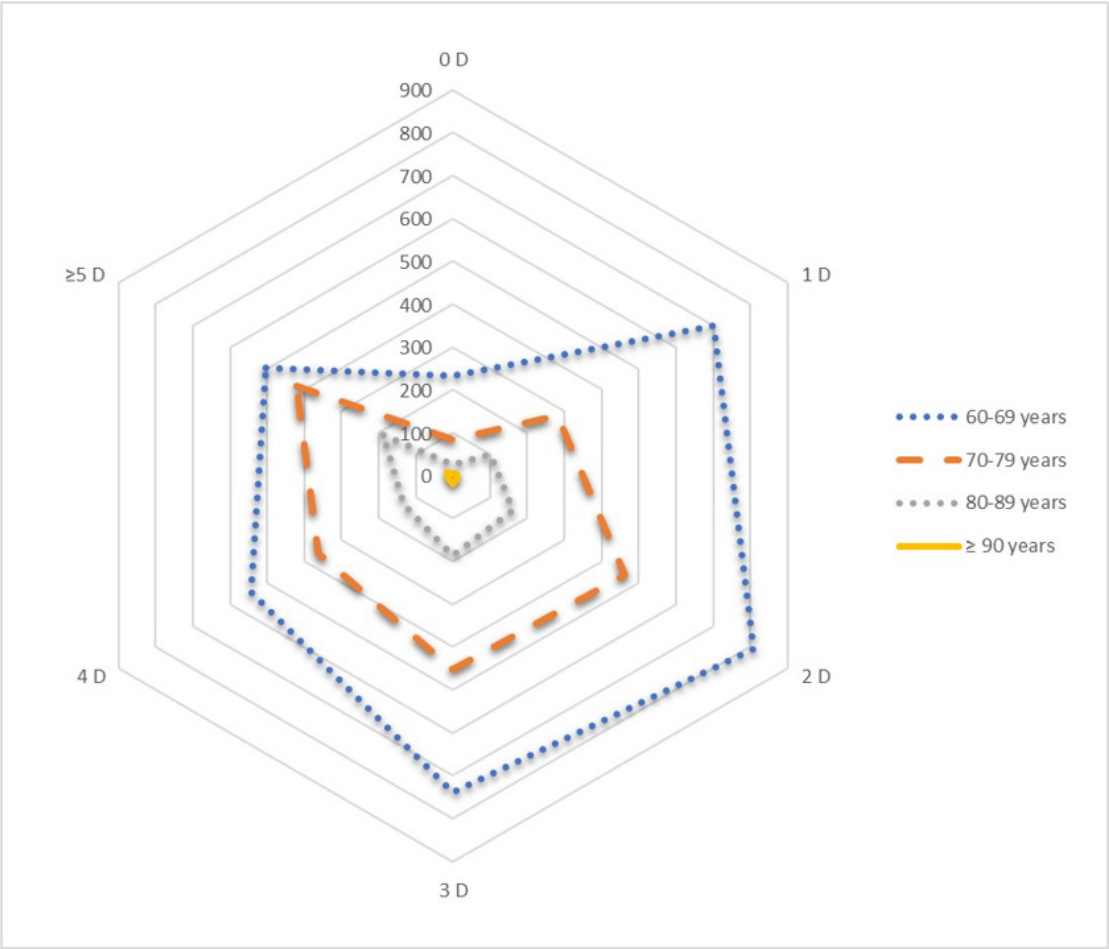


Fig 3 - Number of comorbid conditions among study subjects by age group

0 D: T2DM only; 1 D: T2DM + 1 comorbid disease; 2 D: T2DM + 2 comorbid diseases; 3 D: T2DM + 3 comorbid diseases; 4 D: T2DM + 4 comorbid diseases; ≥5 D: T2DM + ≥5 comorbid diseases

T2DM: type 2 diabetes mellitus

Table 3

Cost in Thai Baht to the Thai government per year for hospital visits

Variables	T2DM without multimorbidity	T2DM with multimorbidity				
		T2DM + 1 disease	T2DM + 2 diseases	T2DM + 3 diseases	T2DM + 4 diseases	T2DM + ≥5 diseases
Median (IQR) number of hospital visits per year	4 (2, 6)	5 (3, 8)	6 (4, 9)	7 (5, 10)	8 (5, 12)	10 (7,14)
Median (IQR) out-patient cost in Thai Baht to the government per person per year	1698.00 (521.50, 3211.00)	3057.00 (1510.00, 5628.50)	4634.75 (2924.50, 7183.50)	5986.50 (3720.00, 8738.75)	6775.00 (3827.25, 9966.00)	7538.00 (4863.25, 11497.38)
Median (IQR) out-patient cost in Thai Baht per patient per year	0 (0, 0)	0 (0, 0)	0 (0, 15)	0 (0, 0)	0 (0, 0)	0 (0, 0)

IQR: interquartile range; T2DM: type 2 diabetes mellitus

Table 4

Prescribed laboratory tests and results by number of comorbid conditions among study subjects

Laboratory tests	T2DM without multimorbidity (T2DM only) N = 348	T2DM with multimorbidity				
		T2DM + 1 disease N = 1,090	T2DM + 2 diseases N = 1,444	T2DM + 3 diseases N = 1,398	T2DM + 4 diseases N = 1,054	T2DM + ≥5 diseases N = 1,126
HbA1c						
Ordered yearly	183 (52.59)	648 (59.45)	1042 (72.16)	1049 (75.04)	867 (82.26)	924 (82.06)
Goal* (≤7.0%)	92 (50.27)	97 (14.97)	170 (16.31)	208 (19.83)	200 (23.07)	256 (27.71)
HDL						
Ordered yearly	110 (31.61)	435 (39.91)	772 (53.46)	935 (66.88)	787 (74.67)	859 (76.29)
Goal* (>40 mg/dl in males and >50 mg/dl in females)	99 (90.00)	355 (81.61)	685 (88.73)	810 (86.63)	639 (81.19)	635 (56.39)
TG						
Ordered yearly	110 (31.61)	437 (40.09)	783 (54.22)	936 (66.95)	793 (75.24)	861 (76.47)
Goal* (<150 mg/dl)	64 (58.18)	244 (55.84)	477 (60.92)	563 (60.15	494 (62.30)	0 (0.00)

*DAT/EST/DMS-MOPH/NHSO, 2017

T2DM: type 2 diabetes mellitus; HbA1c: hemoglobin A1c; HDL: high-density lipoprotein; mg/dl: milligrams per deciliter; TG: triglyceride

was 92 (50.27%) among those with no comorbid conditions and 256 (27.71%) among those with ≥5 comorbid conditions.

HDL cholesterol testing

110 subjects (31.61%) with no comorbid conditions had their high-density lipoprotein (HDL)-cholesterol levels checked and 859 subjects (76.29%) with ≥5 comorbid conditions had their HDL-cholesterol levels checked. Among those with no comorbid conditions, 99 subjects (90.00%) had an HDL-cholesterol level within the target range (males ≥40 mg/dl, females ≥50 mg/dl) and among those with ≥5 comorbid conditions, 635 (56.39%) had an HDL-cholesterol level within the target range.

TG testing

110 subjects (31.61%) with no comorbid conditions had their triglyceride (TG) levels checked and 861 subjects (76.47%) with ≥5 comorbid conditions had their TG levels checked. Among those with no comorbid conditions, 64 subjects (58.18%) had a TG level within the target range (<150 mg/dl) and among those with ≥5 comorbid conditions, 0 (0.0%) had a TG level within the target range.

DISCUSSION

In Part 1 of our study, 71.35% of patients with type 2 diabetes mellitus (T2DM) were found to have multimorbidity, reflecting a considerable disease burden on society. This finding is similar to a previous study (Li *et al*, 2024) which reported 97.54% of their elderly subjects with T2DM had multimorbidity. A reason for this difference in prevalence could be that their study was conducted in an urban population and ours was a nationwide survey covering urban, suburban and rural populations. Urban lifestyle and diet are more conducive of multimorbidity due to being more sedentary and having access to fast food, a risk factor for multimorbidity.

In Part 1 of our study, the gender with the greater proportion of multimorbidity was females (65.82%). This result is consistent

with the findings of studies from Korea (56.7%) (Ko *et al*, 2023) and Iran (55.3%) (Hashemi *et al*, 2024) who also reported a higher proportion of female subjects with multimorbidity. However, the percentage of female subjects with multimorbidity was higher in our study than in their studies. A previous study from Thailand reported a high percentage of female subjects with a metabolic disorder (66.35%) (Suapumee and Naksrisang, 2024). This high prevalence of metabolic disorders among females supports our findings and suggests a reason for our findings, that the high prevalence of metabolic disorders has contributed to the high prevalence of multimorbidity found in our study.

In Part 1 of our study, 71.72% of subjects who received care at the PLC institutions, had at least one comorbid condition. This finding is consistent with, but less than the >90% noted in a study from China (Li *et al*, 2024). This suggests primary care institutions in China are able to care for elderly diabetic patients with multimorbidity.

In Part 1 of our study, 25.82% of subjects received care at the secondary level institutions and 22.70% received care at the tertiary level institutions. This suggests a larger proportion of subjects receiving care at secondary and tertiary level institutions should be managed by PLC institutions, which would reduce the financial burden of these subjects on the public health system in Thailand. A study from Thailand (Waramit, 2025) compared treatment outcomes of subjects with T2DM who received care at PLC and tertiary level institutions and found no significant difference in treatment outcomes.

In Part 2 of our study, the 3 most common comorbid conditions were hypertension, renal insufficiency, and dyslipidemia. A previous study from China (Li *et al*, 2024) reported the 3 most common comorbid conditions were hypertension, dyslipidemia and chronic obstructive pulmonary disease (COPD). The reason for this

difference between their study and ours could be a difference in study populations (Yu *et al*, 2024) and the possible lower proportion of subjects in our study who smoked.

In Part 2 of our study, the percentages of subjects without and with comorbid conditions who had a HbA1c test were 52.59% and 82.06%, respectively, similar to previous studies from Thailand (Waramit, 2025; Somanawat *et al*, 2020) that reported findings of 58.2-62.6% and 88.3%, respectively. Our findings suggest a greater need to monitor HbA1c levels among patients with and without comorbid conditions at the studied PLC institutions.

In Part 2 of our study, 50.27% and 27.71% of subjects without and with ≥5 comorbid conditions at studied PLC institutions reached the HbA1c goal of <7%, respectively, similar to the findings of previous studies from Thailand (Waramit, 2025; Somanawat *et al*, 2020) who reported percentages of 24.0-28.4% and 28.9%, respectively.

In Part 2 of our study, HDL cholesterol levels were checked in 31.61% and 76.29% and triglyceride levels were checked in 31.61% and 76.47% of subjects without and with ≥5 comorbid conditions, respectively. These results show the need to improve monitoring of HDL cholesterol and triglyceride levels among subjects both without and with comorbid conditions at the studied PLC institutions.

In summary, in our study population, the proportion of subjects with multimorbidity was relatively high and much of the care at the PLC study institutions did not meet recommended guidelines. The most commonly seen comorbid conditions at study sites were hypertension, renal insufficiency and dyslipidemia. More women than men had T2DM with multimorbidity. We conclude there is a need to improve the care of elderly patients with T2DM, especially those with multimorbidity, at the study institutions. Further studies are needed to determine what factors caused the failure to reach care

guidelines in the study population and how to improve compliance rates with those guidelines, in order to reduce morbidity and mortality in the study population.

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CONFLICT OF INTEREST DISCLOSURE

The authors declare no conflict of interest.

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